Lingcod Maturity Cruise off Southwest Vancouver Island and in Queen Charlotte Sound, R/V *G.B. Reed*, August 20 - September 5, 1985

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LINGCOD MATURITY CRUISE OFF SOUTHWEST VANCOUVER ISLAND AND IN QUEEN CHARLOTTE SOUND, R/V G.B. REED, AUGUST 20 - SEPTEMBER 5, 1985

by

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ABSTRACT

Cass, A. J., J. R. Selsby, and L. J. Richards. 1986. Lingcod maturity cruise off southwest Vancouver Island and in Queen Charlotte Sound, R/V G.B. REED, August 20 - September 5, 1985. Can. Data. Rep. Fish. Aquat. Sci. 594: 78 p.

Between August 20 and September 5 1985 the R/V G.B. REED was used to trawl for lingcod off southwest Vancouver Island and in Queen Charlotte Sound. The primary purpose of the cruise was to collect data on the reproductive biology of lingcod. Fork length, round weight, ovary weight, length-maturity and stomach contents data are presented. The effect of area of capture on size composition and ovary-somatic weight relationships was examined.

There were no apparent differences between maturity stages observed off southwest Vancouver Island and in Queen Charlotte Sound. All mature females were in an early stage of maturity with ova diameter less than 1 mm. Off southwest Vanvouver Island 50% maturity occurred at a length of 65 cm (fiducial limits = 63-66 cm). In Queen Charlotte Sound this occurred at 69 cm (fiducial limits = 66-71 cm). All the males examined were considered mature and in a resting stage.

RESUME

Cass, A. J., J. R. Selsby, and L. J. Richards. 1986. Lingcod maturity cruise off southwest Vancouver Island and in Queen Charlotte Sound, R/V G.B. REED, August 20 - September 5, 1985. Can. Data. Rep. Fish. Aquat. Sci. 594: 78 p.

Du 20 août au 5 septembre 1985, le navire de recherche G.B. REED a été utilisé pour la pêche au chalut de la morue-lingue au sud-ouest de l'île de Vancouver et dans le détroit de la Reine-Charlotte. Cette pêche avait pour but premier la collecte de données sur la biologie de la reproduction de la morue-lingue. Les auteurs présentent des données sur la longueur à la forche, le poids entier, le poids des ovaires, la longueur à maturité et le contenu stomacal et traitent du rapport entre la zone de capture et la distribution des tailles et la relation poids des ovaires - poids corporel.

Il n'y avait aucun écart apparent entre les étapes de maturité notées au sud-ouest de l'île Vancouver et dans le détroit de la Reine-Charlotte. Toutes les femelles matures étaient au début du stade, le diamètre des oeufe était inférieur à un mm. Au sud-ouest de l'île de Vancouver, le niveau de maturité de 50 % était atteint à une longueur de 65 cm (limites fiduciaires de 63-66 cm); cette valeur était de 69 cm (limites fiduciaires de 66-71 cm) chez les poissons du détroit de la Reine-Charlotte. Tous des mâles examinés étaient matures et en stade de repos.

INTRODUCTION

The major fisheries for lingcod occur in three geographic regions off Canada's west coast. In the vicinity of La Perouse Bank off southwest Vancouver Island and in Queen Charlotte Sound there is an offshore trawl fishery. In the Strait of Georgia there is a hook and line fishery (recreational and commercial). In 1985 a study was initiated to estimate the reproductive potential of lingcod in these three areas. During August - September 1985 the R/V G. B. Reed was used to trawl for lingcod off southwest Vancouver Island and in Queen Charlotte Sound. The catch of lingcod was sampled for fork length, round weight, ovary weight, stomach contents, maturity and fecundity. This report presents our methods and preliminary results. A survey of the Gulf Island area of the Strait of Georgia was conducted during November - December 1985. Results of that survey are contained in another report (Cass et al. in preparation).

METHODS

Between August 20 and September 5 1985 the R/V G. B. REED was used to trawl for lingcod on known commercial fishing grounds on La Perouse Bank off southwest Vancouver Island and in central Queen Charlotte Sound (Fig. 1). Cruise dates were selected to coincide with the period just prior to the fall decine in lingcod availability and the segregation of male and female lingcod. Catch and effort data for the commercial trawl fishery show that lingcod, in general, become less vulnerable to trawl gear from late September through April. The sex ratio of lingcod in biological samples indicates males are almost totally unavailable to trawling during this period.

An Atlantic Western III bottom trawl, equipped with a 8.9 cm mesh cod-end, 50-cm rubber bobbins and a 35 m footrope, was used on all tows. The total catch from each tow was sorted by species into 12 L plastic tubs. The tubs were weighed using an on-deck platform scale to obtain the total weight of the catch by species. Individual lingcod were weighed using a 100-kg capacity clock-scale to the nearest 0.1 kg, measured for fork length to the nearest mm and examined for sex. The 4th-8th second dorsal fin-rays were collected for age determinations using the method of Beamish and Chilton (1977). Results from age determinations will be presented elsewhere. Maturity stages were categorized according to the method of Cass et al. (1984a). Ovaries of mature females were weighed using a Digimetric or Ktron electronic balance to the nearest g and preserved in Gilson's solution for fecundity analysis. A later examination showed the ovaries were not sufficiently developed to permit reliable estimates of fecundity. Samples of ovaries and testes were preserved for histological examination in Smith's formal-dichromate and bouins solution, respectively. The chemical compositions of Gilson's and Smith's formal-dichromate used in this study are those reported in Leaman et al. (1985). Stomach contents were examined and an estimate of the total volume and percentage of each prey species was recorded.

An expendable bathythermograph (XBT) was used to record the water temperature at depth following the first set at each fishing site.

RESULTS AND DISCUSSION

GENERAL CRUISE SUMMARY

A total of 33 sets were completed; 15 off southwest Vancouver Island (Fig. 2) and 18 in Queen Charlotte Sound (Fig. 3). Sets ranged from 10-89 minutes in duration and averaged 40 min. The modal depths for each set ranged from 64-114 m. Off southwest Vancouver Island lingcod were caught from two distinct depth ranges. Sets 1-10 occurred at modal depths of 90-100 m. Sets 11-14 occurred at modal depths of 64-67 m (Fig. 2). In Queen Charlotte Sound lingcod were caught at modal depths of 82-102 m (Fig. 3). Information on the depth, duration, time, direction, position and the catch by species for each set is presented in Appendix 1. Water temperature profiles by depth and set are presented in Appendix 2.

Off southwest Vancouver Island lingcod accounted for 34% of the total catch by weight and was dominant in three sets (sets 2, 9, 12). Spiny dogfish (28%), arrowtooth flounder (13%) and Pacific halibut (8%) were also abundant in catches off southwest Vancouver Island. In Queen Charlotte Sound lingcod accounted for 22% of the catch and was dominant in 5 sets (sets 18, 19, 25, 26 and 31). Other abundant species in catches from Queen Charlotte Sound were long-nose skate (19%), Pacific halibut (14%) and rock sole (12%).

Catch rates of lingcod averaged 264 kg/h of trawling off southwest Vancouver Island and 163 kg/h in Queen Charlotte Sound.

A summary of the measurements collected from lingcod is presented in Table 1. Length, weight, sex, maturity and ovary weight for each fish sampled is presented by set in Appendix 3. Stomach contents of each lingcod examined are listed in Appendix 4.

SEX AND SIZE COMPOSITION

Females dominated the catch of lingcod in all sets and accounted for 62% and 63% of the catch off southwest Vancouver Island and in Queen Charlotte Sound, respectively. Males in this study (n=118) ranged from 47-101 cm fork length with a mean and one standard error of 70.1±0.8 cm. The weights of males ranged from 0.9-10.0 kg with a mean of 3.8±0.1 kg. Lengths of females (n=397) ranged from 36-123 cm with a mean of 81.1±0.6 cm. The weights of females ranged from 0.3-22.1 kg with a mean of 5.7±0.1 kg.

We used the Wilcoxon rank sum test to examine the effect of sex on lingcod size. Sex differences in median length and weight were highly significant ($p<0.001$). Although age determinations were not completed for this report, the difference in size may be attributed to slower growth rates of males (Chatwin 1956; Beamish and Chilton 1977; Cass and Beamish 1983).

The sex and size composition of lingcod varied according to depth and area of capture (Figs. 4-7). As lingcod were caught at two distinct depth ranges off southwest Vancouver Island, we were able to test the effect of depth on sex and size composition. We compared combined catches from sets 1-10 (90-100 m) with catches from sets 11, 13 and 14 (64-67 m). We excluded set 12 results because of the stratified sampling used for this set. Differences in sex composition between these two depth ranges were significant (chi-square test; $p<0.005$). Females dominated the catch in all sets, although males were relatively more abundant in catches from the shallow depth range. The difference in median length and weight between the two depth ranges were significant for both sexes (Wilcoxon rank sum test; $p<=0.001$). Larger lingcod of both sexes were caught in the deeper depth range (Fig. 4 and 5). A decrease in the proportion of males and an increase in the size of both sexes of lingcod with increasing depth has been found in other studies (Cass et al. 1984b, 1985).

To test for area effects on median size we compared lingcod size distributions from southwest Vancouver Island and Queen Charlotte Sound (Figs. 6 and 7). To eliminate extraneous effects of depth we excluded catches from depth ranges of 64-67 m. Stratified samples were also excluded (sets 32 and 12). Differences in median length and weight were not significant for males (Wilcoxon rank sum test; $p>0.5$) but were highly significant for females ($p<0.001$).

The size composition of lingcod, summarized by depth and area, is presented in Table 2.

WEIGHT-LENGTH RELATIONSHIPS

The relationship between round weight and fork length for each sex of lingcod from off southwest Vancouver Island and from Queen Charlotte Sound is shown in Figures 8-9. Parameter estimates and corresponding r^2 values for the weight-length regression $W = aL^b$, where W is weight and L is fork length, are presented in Table 3 for each area and sex.

MATURITY

Maturity stages of lingcod were categorized according to the descriptions presented in Table 4. Of the females examined off southwest Vancouver (n=150), 82% were mature. Of the female examined from Queen Charlotte Sound (n=247), 93% were mature. There were no apparent differences

between the maturity stages observed off southwest Vancouver Island and in Queen Charlotte Sound. All mature females were in an early stage of maturity (Stage 3) with ova diameter less than 1 mm. In a small number of females (3%), it was difficult to distinguish between mature and immature individuals. The ovaries in these fish consisted largely of connective tissue, interdispersed with a granule-like substance that resembled very small oocytes. These fish were assumed to be immature for purposes of this report. Samples of these ovaries were saved for later histological examination. Other studies have shown that ovaries in small adult females develop later than in larger adults (Cass et al. 1984a).

The number of mature females at 1-cm length intervals is given in Table 5. Maturity ogives for female lingcod are shown in Figure 10. The smallest mature female was 60 cm and the largest immature female was 68 cm. The length at 50% maturity was estimated using probit analysis. Off southwest Vancouver Island 50% maturity occurred at a length of 65 cm (fiducial limits = 63-66 cm). In Queen Charlotte Sound this occurred at 69 cm (fiducial limits = 66-71 cm). By comparison, in November-December 1977 off southwest Vancouver Island 50% of the females were mature at a length of 76 cm (fiducial limits = 75-77 cm) (Cass et al. 1984a). This represents a decrease of 11 cm in the size at 50% maturity over the 8-yr period. It is unlikely that the decrease is due to the months in which the sampling occurred. Growth rates of adult female lingcod, as estimated from other studies, are approximately 5-6 cm/yr (Cass et al. 1983, 1984a, 1984b).

The relationship between ovary weight and somatic weight (round weight minus ovary weight) for lingcod from southwest Vancouver Island and Queen Charlotte Sound is approximately linear (Fig. 11). Parameter estimates and r^2 values for the linear regression $WO = a + b_y WS$, where WO is the ovary weight and WS is the somatic weight, for the two areas are as follows:

AREA	a	b	r^2	n
SOUTHWEST VANCOUVER ISLAND	-65.52	0.025	0.93	166
QUEEN CHARLOTTE SOUND	-66.63	0.022	0.87	239

We tested for differences in the ovary-somatic weight relationships between the two areas to determine whether there were differences in the reproductive potential between the two stocks. There was no significant difference in either the intercept or the slope of the regression (F-tests; $p>0.10$).

As for females, there were no apparent differences in the maturity stages of males between the two areas. All the males examined (n=118) were considered to be mature and in a resting stage (Stage 11). It should be noted that resting stages of small males are difficult to distinguish from immature males. Testes were collected for histological study in an attempt to validate the criteria used to assess male maturities (Table 4).

STOMACH CONTENTS

The stomach contents of individual lingcod examined are listed in Appendix 3 by set. Stomachs of 322 lingcod caught off southwest Vancouver Island were examined. Stomachs of 57% of the lingcod were empty. Stomachs of the remaining fish contained a variety of food items. The mean volume of food ingested, including empty stomachs, was 70.3 cc. Pacific herring accounted for 57% of the volume and was the dominant food item in the 84% of the stomachs that contained identifiable items. Pacific hake accounted for 33% of the volume and was the dominant food item in 12% of the fish. Butter sole and octopus accounted for 1% of the volume. Digested shrimp accounted for less than 1% of the volume. Unidentified fish remains and unidentified digested matter each accounted for 4% of the volume.

Stomachs of 337 lingcod caught in Queen Charlotte Sound were examined. Stomachs of 30% were empty. The mean volume of the stomach contents, including empty stomachs, was 40.5 cc. Pacific herring accounted for 37% of the volume and was the dominant food item in the 29% of the stomachs that contained indentifiable items. Pacific sand lance was not found in any of the stomachs off southwest Vancouver Island, but was dominant in 70% of the stomachs examined from Queen Charlotte Sound and accounted for 33% of the volume. Arrowtooth flounder was present in one stomach and accounted for 8% of the volume. Flathead sole, Pacific lamprey, and squid each accounted for less than 1% of the volume ingested. Unidentified fish remains accounted for 12% of the volume. Unidentified digested matter accounted for 10% of the volume of food ingested.

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REFERENCES

Beamish, R. J. and D. Chilton. 1977. Age determination of lingcod (Ophiodon elongatus) using dorsal fin rays and scales. J. Fish. Res. Board Can. 34: 1305-1313.

Cass, A. J. and R. J. Beamish. 1983. First evidence of validity of the fin-ray method of age determination for marine fishes. North Am. J. Fish. Manage. 3: 182-188.

Cass, A. J., R. J. Beamish, and M. S. Smith. 1984a. Study of the biology of lingcod off the west coast of Vancouver Island, M/V ARCTIC HARVESTER, November 22-December 2, 1977. Can. Data Rep. Fish. Aquat. Sci. 461: 71 p.

Cass, A. J., E. Cameron, and I. Barber. 1983. Lingcod tagging study off southwest Vancouver Island, M/V PACIFIC EAGLE - July 14-27, 1982. Can. Data Rep. Fish. Aquat. Sci. 406: 84 p.

Cass, A. J., G. A. Mcfarlane, K. Rutherford and J. Barber. 1984b. Lingcod tagging study in the Strait of Georgia, November 1982-March 1983. Can. MS Rep. Fish. Aquat. Sci. 1791: 49 p.

Cass, A. J., G. A. McFarlane, M. S. Smith, I. Barber, and K. Rutherford. 1985. Lingcod tagging study in the Strait of Georgia 1983-84. Can. MS Rep. Fish. Aquat. Sci. (in press).

Chatwin, B. M. 1956. Age and growth of lingcod (Ophiodon elongatus). Fish. Res. Board Can. Pacific Prog. Rep. 99: 14-17.

Leaman, B. M., D. A. Nagtegaal, R. D. Stanley, and E. W. Carter. 1985. Rockfish fecundity cruise (GBR-R82-1), November 8-28, 1982. Can. Data Rep. Fish. Aquat. Sci. 526: 64 p.

TABLE 1. A summary of measurements collected from lingcod by set, R/V G.B. REED, August 20 - September 5 1985.

SET NO.	FORK LENGTH	ROUND WEIGHT	DORSAL FIN-RAYS	MATURITY	OVARY WEIGHT	STOMACH CONTENTS	HISTOLOGY	SAMPLE[a] TYPE
1	2	2	2	2	2	2	0	T.C.
2	80	79	80	80	54	80	8	T.C.
3	18	18	18	18	13	17	0	T.C.
5	6	6	6	6	2	6	1	T.C.
6	9	9	9	9	7	9	0	T.C.
8	8	8	8	8	6	8	1	T.C.
9	16	16	16	16	4	16	3	T.C.
10	12	12	12	12	6	12	1	T.C.
11	12	12	12	12	4	12	1	T.C.
12	129	129	129	129	71	129	3	STRAT.[b]
13	21	21	21	21	0	21	2	T.C.
14	10	10	10	10	2	10	0	T.C.
16	10	10	10	10	1	10	2	T.C.
17	4	4	4	4	3	4	0	T.C.
18	42	42	42	42	36	42	4	T.C.
19	39	39	39	39	32	39	6	T.C.
20	36	36	36	36	31	36	1	T.C.
21	5	5	5	5	2	5	0	T.C.
22	6	6	6	6	4	6	0	T.C.
23	14	14	14	14	4	14	2	T.C.
24	6	6	6	6	5	6	2	T.C.
25	25	25	25	25	21	25	1	T.C.
26	35	35	35	35	28	35	1	T.C.
27	33	33	33	33	20	33	1	T.C.
29	3	3	3	3	2	3	0	T.C.
30	2	2	2	2	0	2	0	T.C.
31	61	61	61	61	46	61	1	T.C.
32	13	13	13	13	5	13	6	STRAT.[c]

[a] T.C. = total catch.

[b] STRAT. = stratified by length for poorly represented lengths in previous samples.

[c] STRAT. = all males and only females $\leq$ 80 cm were sampled.

TABLE 2. A summary of the size composition of lingcod by depth and area of capture, R/V G.B. REED, August 20-September 5 1985. Data from Sets 12 and 32 were stratified by length and are not included in this summary.

	SOUTHWEST VANCOUVER ISLAND		QUEEN CHARLOTTE SOUND	
	MALE	FEMALE	MALE	FEMALE
FORK LENGTH (cm)				
64-67m DEPTH				
sample size	17	26	-	-
range	47-75	36-121	-	-
mean	61.2	66.7	-	-
S.E.	2.2	4.0	-	-
90-102m DEPTH				
sample size	27	122	68	222
range	55-87	45-114	53-101	59-123
mean	71.0	77.3	71.9	84.7
S.E.	1.4	1.3	1.0	0.6
ROUND WEIGHT (kg)				
64-67m DEPTH				
sample size	17	26	-	-
range	0.9-4.5	0.4-19.8	-	-
mean	2.4	3.7	-	-
S.E.	0.3	0.8	-	-
90-102m DEPTH				
sample size	27	122	68	222
range	1.5-7.5	0.5-15.5	1.5-10.0	2.0-22.1
mean	3.9	5.0	4.1	6.3
S.E.	0.3	0.3	0.2	0.2

TABLE 3. Parameter estimates for the log-transform of the weight-length regression; $W = aL^b$, where W is round weight (g) and L is fork length (mm), for lingcod, R/V G.B. REED, August 20-September 5, 1985.

AREA	a	b	r^2	n
SOUTHWEST VANCOUVER ISLAND				
MALES	-13.86	3.37	0.96	60
FEMALES	-13.32	3.27	0.96	258
QUEEN CHARLOTTE SOUND				
MALES	-13.29	3.28	0.93	80
FEMALES	-11.83	3.05	0.92	252

TABLE 4. Codes used to describe lingcod maturity stages, as modified from Cass et al. (1984a).

MATURITY	CODE	GONAD CONDITION
	0	Unknown
	1	Immature; (males stringlike; females small)
	2	Immature; (males flat, transparent and slightly enlarged; females, slightly enlarged)
Females	3	Ova are semi-transparent and less than 1 mm in diameter, ovaries fills one-third of the body cavity
	4	Ova are opaque and about 1 mm in diameter, ovaries fills two thirds of the body cavity
	5	Ova are less than 2 mm in diameter, ovaries fills 80% of body cavity
	6	Ova are about 2 mm in diameter
	7	Ripe (ova are larger than 2 mm in diameter, ovaries visibly fill and distend body cavity)
	8	Spent (ovary may be bloodshot and purple in colour, ovary is flaccid and about one-third to two-thirds of the body cavity)
	9	Resorbing (ova are large to opaque and degenerative)
	10	Recovering (ovaries returning to pre-ripening stage (code 3) ovaries are firm and fill less than half the body cavity, ova are small)
	11	Resting (ovaries fill less than one-third of the body cavity, no ova present)
Males	3	Testes enlarged, filling less than one-quarter of the body cavity and white to brown in colour
	4	Testes enlarged to two-thirds of the body cavity, cross-sections of the gonad will produce milt
	7	Ripe (testis are large and full of milt)
	8	Spent (testis are flaccid, reduced in size and may contain some milt)
	11	Resting (testes are less than one-third of the body cavity, usually brown in colour and devoid of milt)

TABLE 5. Summary of the number of male and female lingcod examined and number mature at each centimeter length interval, R/V G.B. REED, August 20 - September 5 1985.

A. SOUTHWEST VANCOUVER ISLAND

FORK LENGTH	MALES		FEMALES	
	EXAMINED	MATURE	EXAMINED	MATURE
36	0	0	1	0
43	0	0	1	0
44	0	0	1	0
45	0	0	2	0
47	2	2	2	0
49	0	0	2	0
50	0	0	1	0
51	2	2	3	0
53	1	1	0	0
54	0	0	2	0
56	2	2	1	0
57	1	1	1	0
58	0	0	3	0
59	1	1	2	0
60	1	1	4	1
61	2	2	8	1
62	2	2	2	1
63	1	1	2	0
64	1	1	2	1
65	5	5	7	7
66	1	1	6	4
67	4	4	5	4
68	4	4	4	4
69	1	1	4	4
70	5	5	6	6
71	4	4	8	8
72	3	3	10	10
73	1	1	9	8
74	5	5	7	7
75	3	3	11	11
76	2	2	9	9
77	0	0	6	6
78	0	0	7	7
79	0	0	10	10
80	2	2	9	9
81	1	1	7	7
82	0	0	9	9

TABLE 5. (CONT'D)

FORK LENGTH	MALES		FEMALES	
	EXAMINED	MATURE	EXAMINED	MATURE
83	0	0	12	12
84	0	0	6	6
85	0	0	16	16
86	0	0	7	7
87	1	1	5	5
88	0	0	4	4
89	0	0	3	3
90	0	0	5	5
91	0	0	5	5
92	0	0	3	3
93	0	0	3	3
94	0	0	4	4
95	0	0	1	1
97	0	0	2	2
99	0	0	1	1
101	0	0	1	1
103	0	0	1	1
104	0	0	2	2
107	0	0	1	1
108	0	0	1	1
110	0	0	1	1
112	0	0	1	1
113	0	0	1	1
114	0	0	1	1
121	0	0	1	1

TABLE 5. (CONT'D)

B. QUEEN CHARLOTTE SOUND

FORK LENGTH (cm)	MALES		FEMALES	
	EXAMINED	MATURE	EXAMINED	MATURE
53	1	1	0	0
55	1	1	0	0
56	1	1	0	0
57	1	1	0	0
58	2	2	0	0
59	0	0	1	0
60	0	0	2	0
62	2	2	0	0
63	3	3	1	1
64	1	1	2	0
65	3	3	1	0
66	1	1	1	1
67	3	3	1	1
68	4	4	0	0
69	4	4	2	1
70	5	5	2	2
71	9	9	2	2
72	4	4	6	6
73	5	5	5	5
74	4	4	3	3
75	3	3	11	10
76	3	3	10	8
77	1	1	7	7
78	6	6	10	10
79	3	3	8	8
80	4	4	9	9
81	0	0	11	10
82	1	1	8	8
83	1	1	13	13
84	0	0	10	10
85	2	2	15	15
86	0	0	8	8
87	0	0	10	10
88	1	1	14	14
89	0	0	9	9

TABLE 5. (CONT'D)

FORK LENGTH (cm)	MALES		FEMALES	
	EXAMINED	MATURE	EXAMINED	MATURE
90	0	0	7	7
91	0	0	11	11
92	0	0	9	9
93	0	0	10	10
94	1	1	6	6
95	0	0	6	6
97	0	0	3	3
98	0	0	4	4
99	0	0	3	3
100	0	0	1	1
101	1	1	3	3
103	0	0	2	2
105	0	0	2	2
106	0	0	1	1
109	0	0	1	1
114	0	0	1	1
123	0	0	1	1

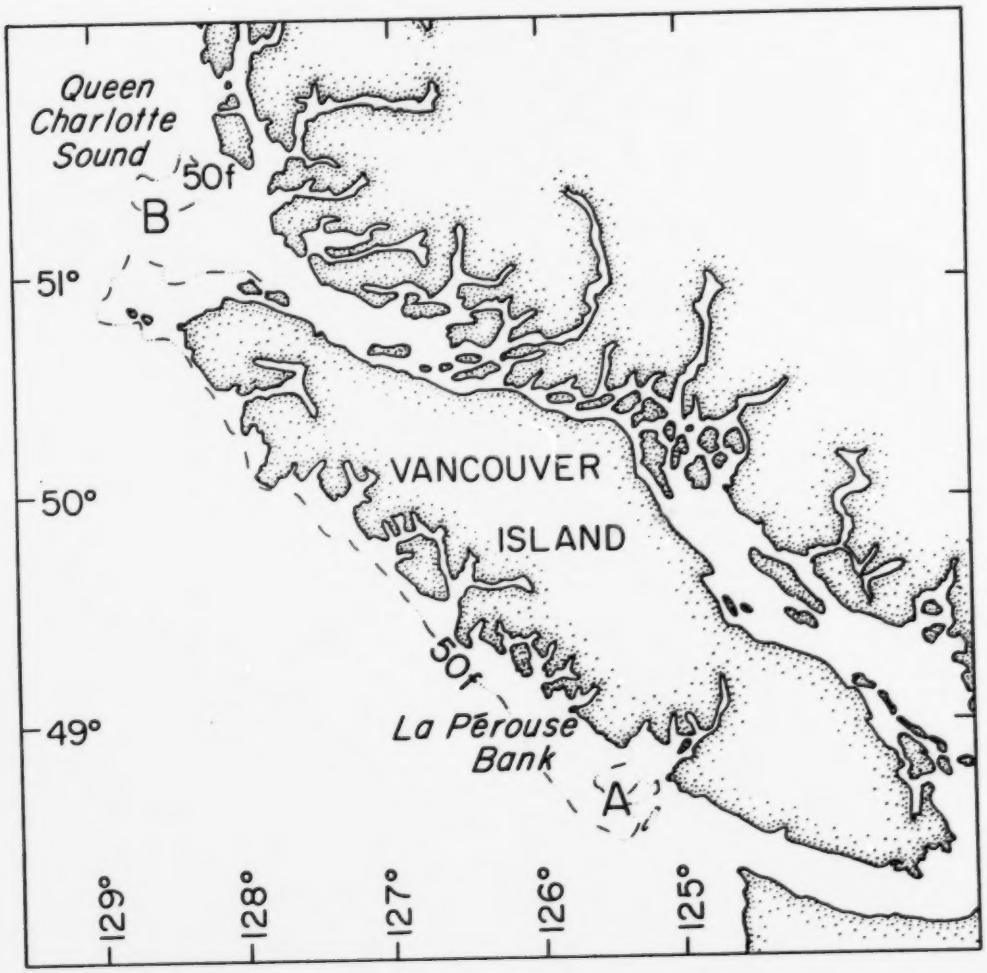

Fig. 1. Areas fished for lingcod A) off southwest Vancouver Island and B) Queen Charlotte Sound, R/V G.B. REED, August 20-September 5, 1985.

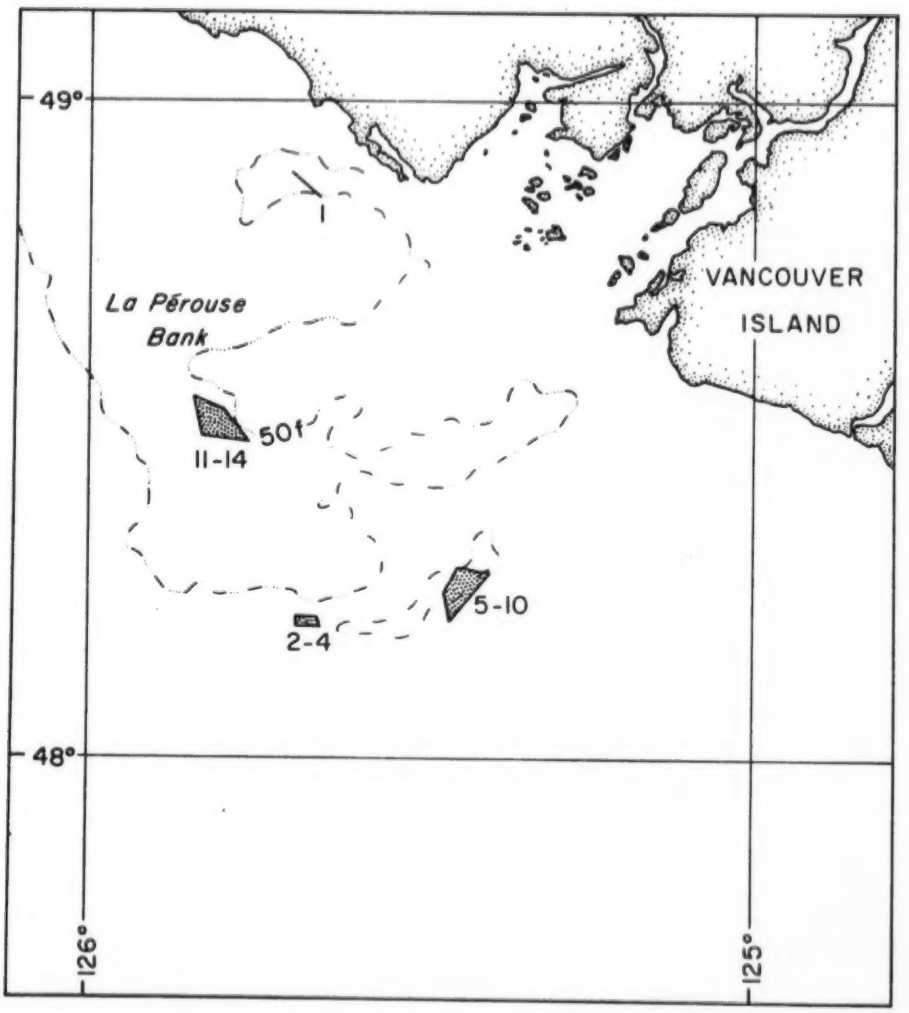

Fig. 2. Set locations off Southwest Vancouver Island, R/V G.B. REED, August 20 - September 5 1985.

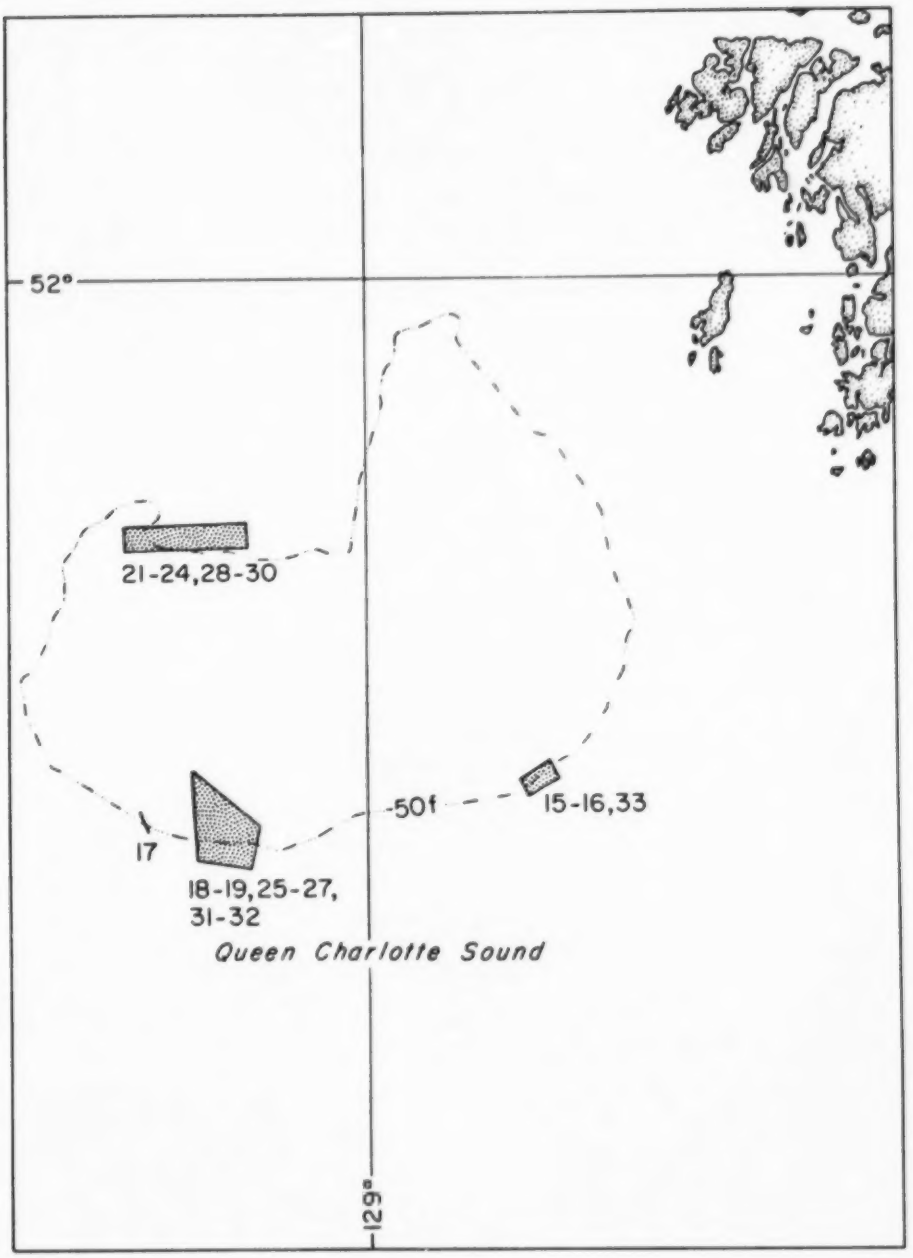

Fig. 3. Set locations in Queen Charlotte Sound, R/V G.B. REED, August 20 - September 5 1985.

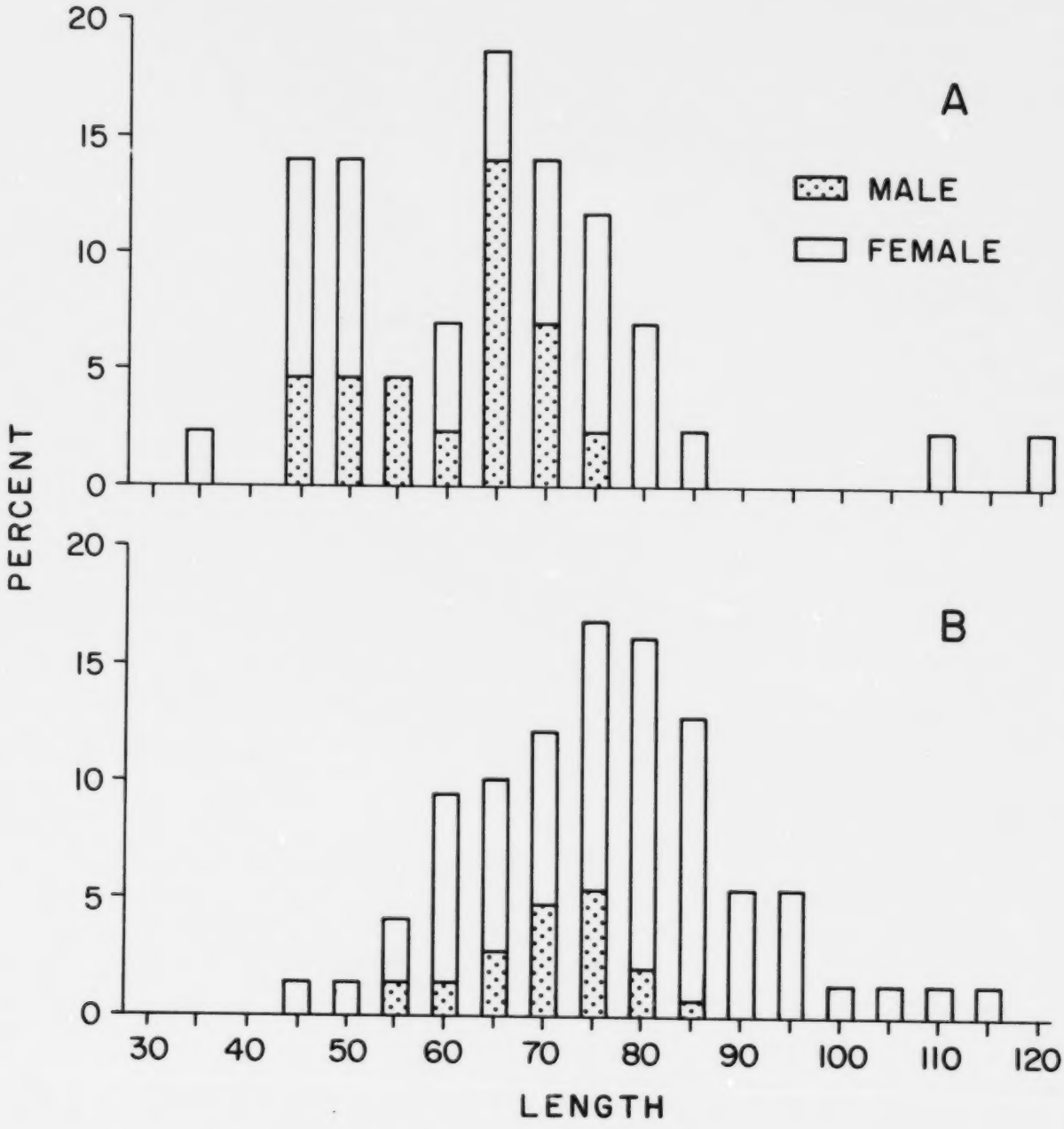

Fig. 4. Length distributions by sex for lingcod sampled off southwest Vancouver Island from A) the 64-67 M depth range and B) the 90-100 M depth range, R/V G.B. REED, August 20 - September 5, 1985. Lengths shown are the midpoints of 5-cm size classes.

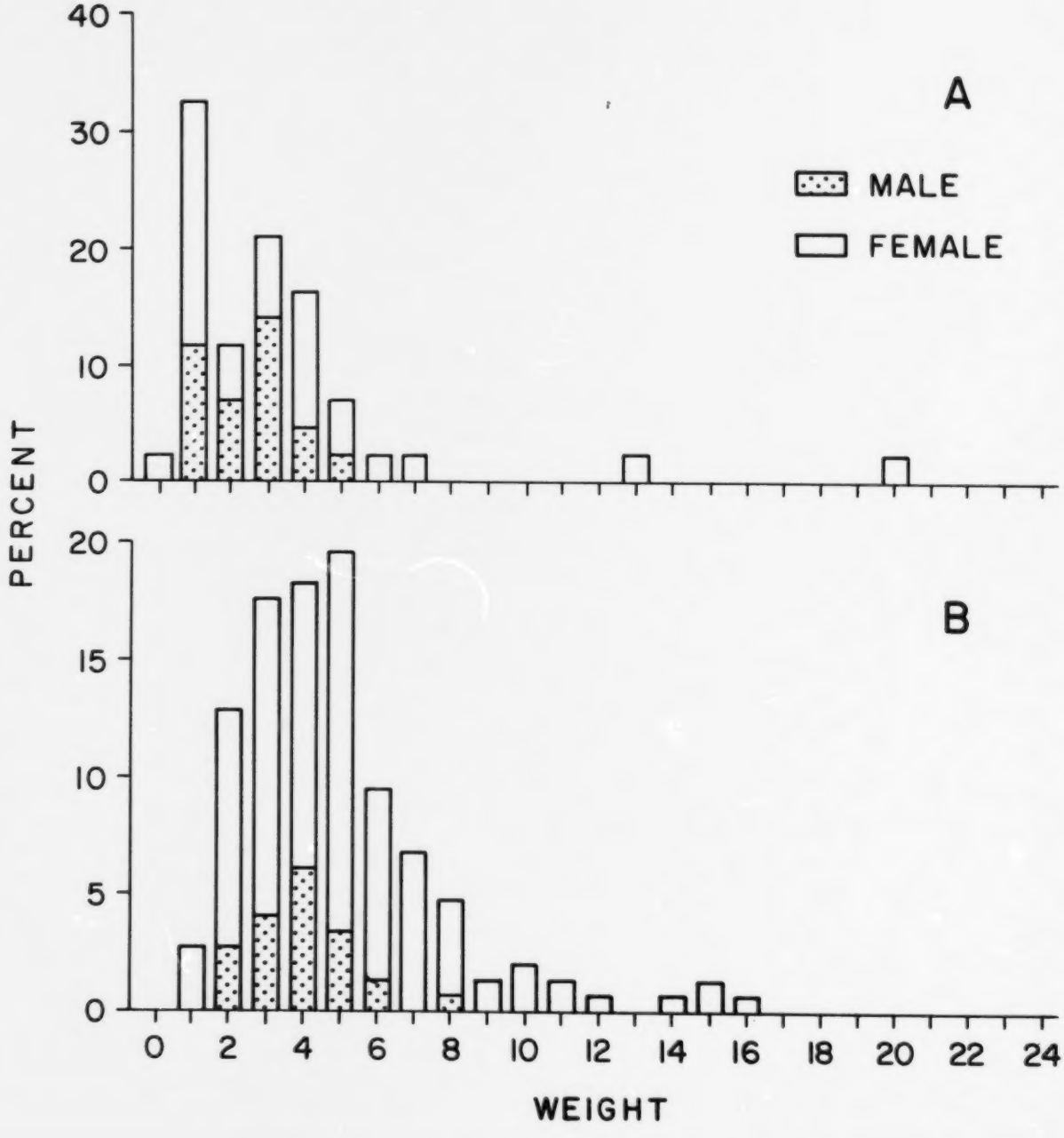

Fig. 5. Weight distributions by sex for lingcod sampled off southwest Vancouver Island from A) the 64-67 M depth range and B) the 90-100 M depth range, R/V G.B. REED, August 20 - September 5, 1985. Weights shown are the midpoints of 1-kg size classes.

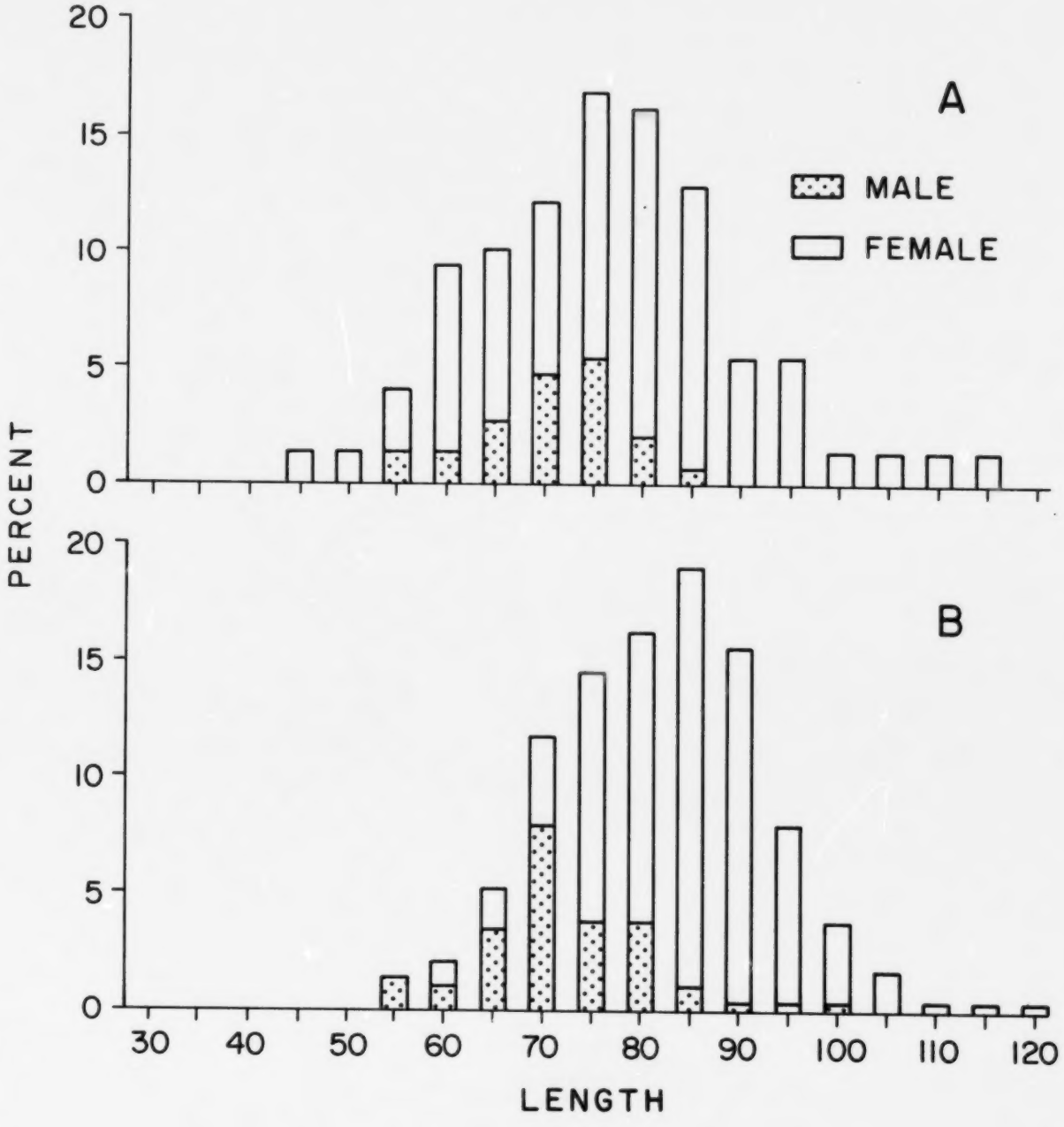

Fig. 6. Length distributions by sex for lingcod sampled from the 90-102 M depth range A) off southwest Vancouver Island and B) Queen Charlotte Sound, R/V G.B. REED, August 20 - September 5, 1985. Lengths shown are the midpoints of the 5-cm size classes.

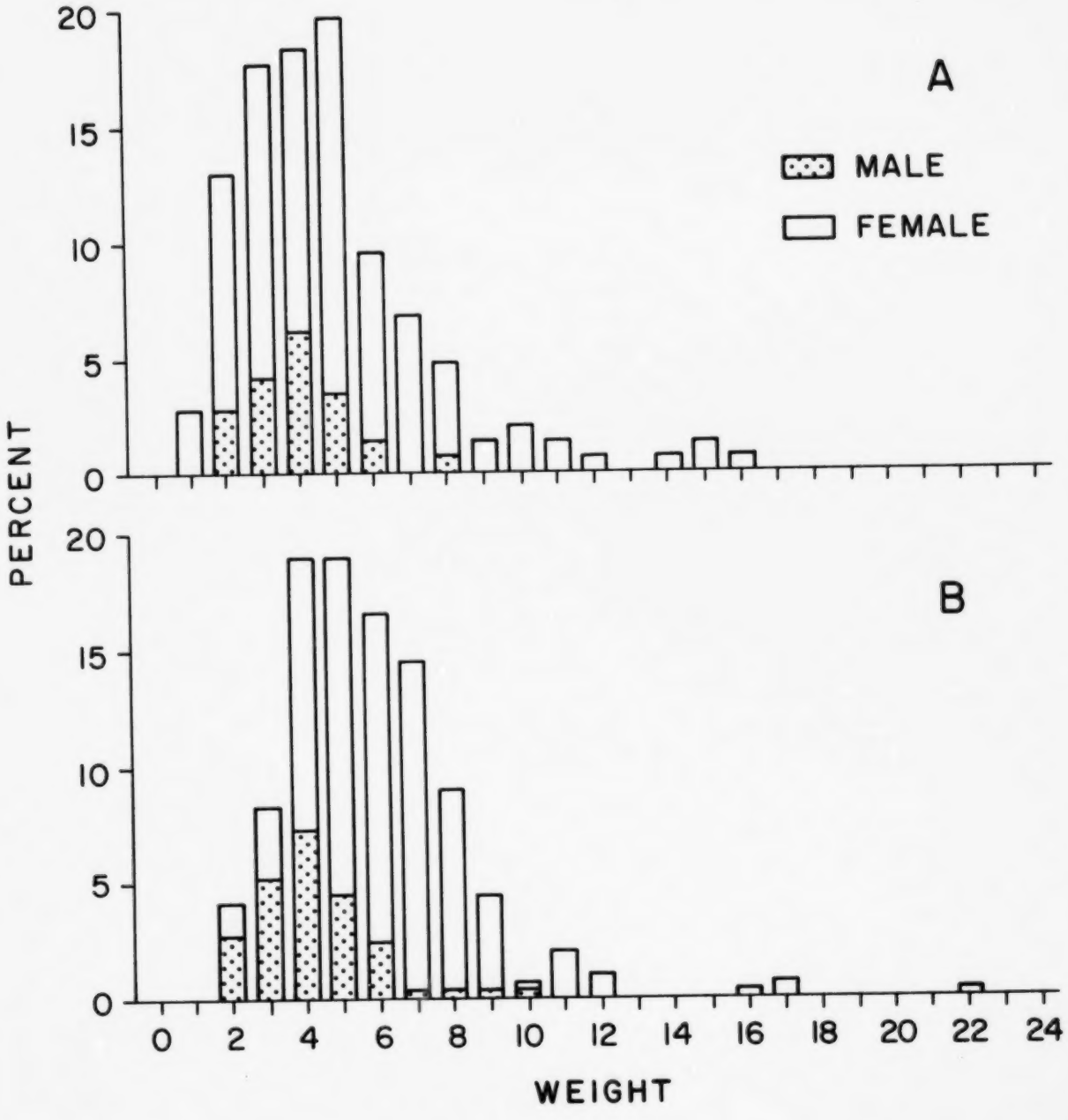

Fig. 7. Weight distributions by sex for lingcod sampled from the 90-102 M depth range A) off southwest Vancouver Island and B) Queen Charlotte Sound, R/V G.B. REED, August 20 - September 5, 1985. Weights shown are the midpoints of the 1-kg classes.

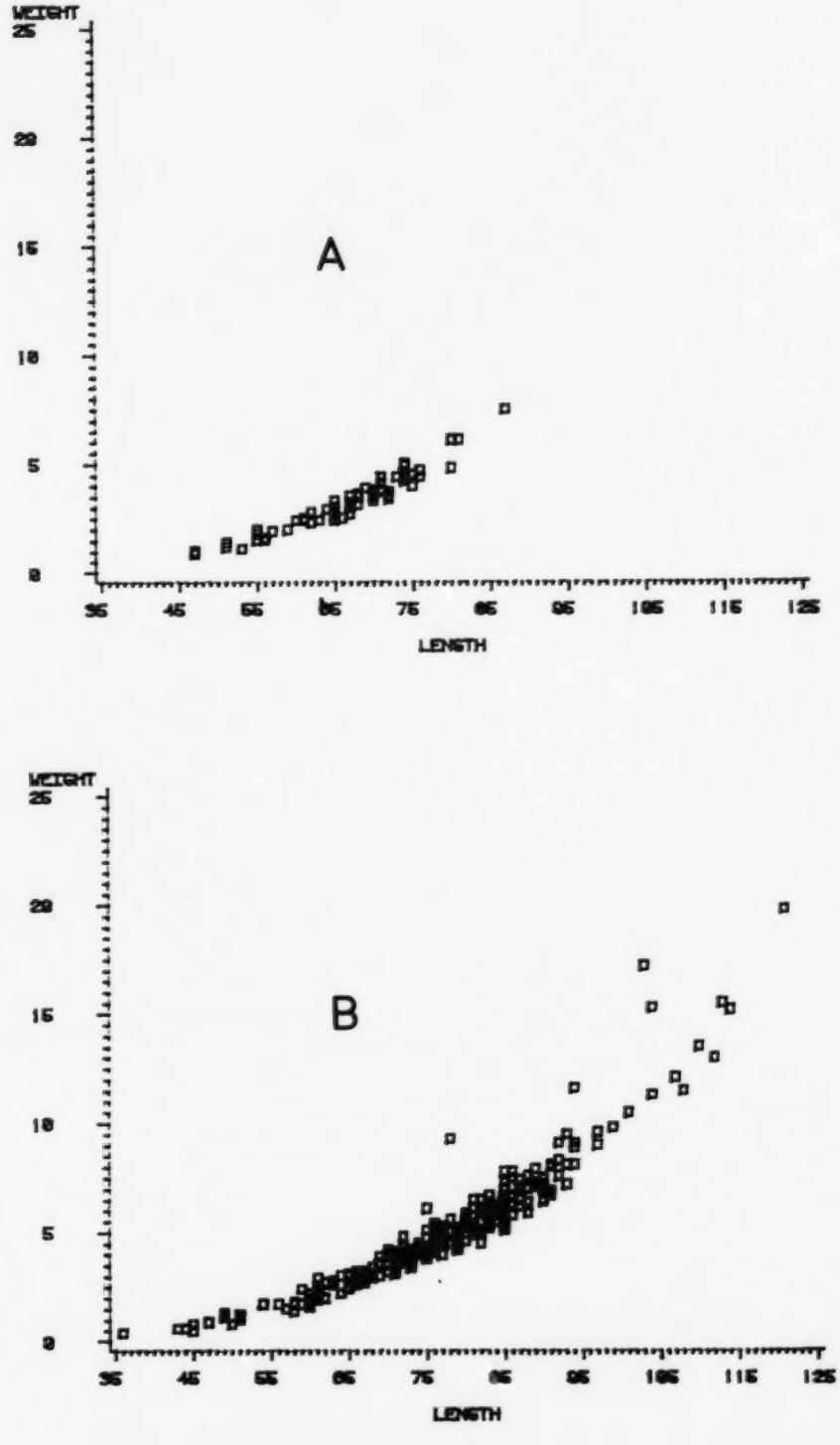

Fig. 8. Weight (kg)-Length (cm) relationships for A) male and B) female lingcod sampled from off southwest Vancouver Island, R/V G.B. REED, August 20 - September 5, 1985.

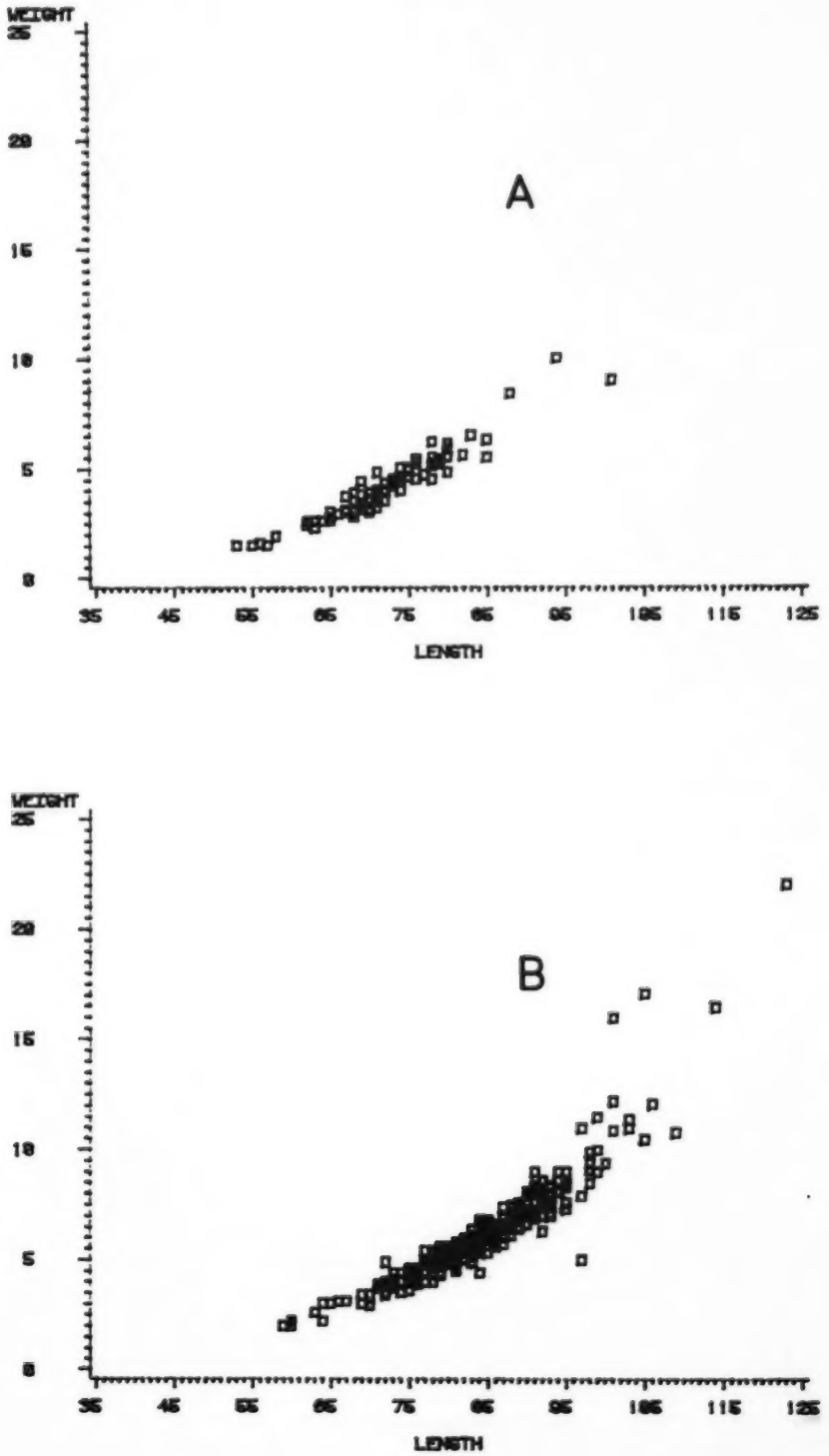

Fig. 9. Weight (kg)-length (cm) relationships for A) male and B) female lingcod sampled from Queen Charlotte Sound, R/V G.B. REED, August 20 - September 5, 1985.

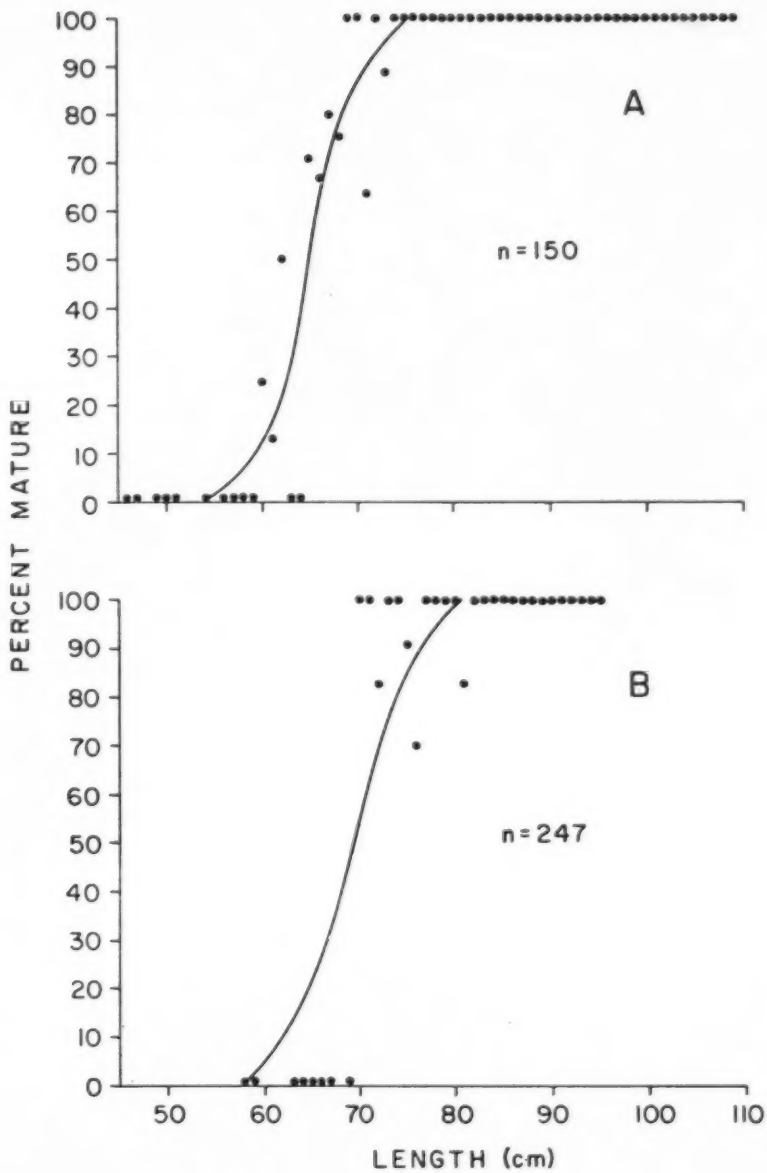

Fig. 10. Maturity ogives for female lingcod sampled from A) off southwest Vancouver Island and B) Queen Charlotte Sound, R/V G.B. REED, August 20 - September 5, 1985. The line shows the probability that a fish of the given length is mature as estimated from probit analysis.

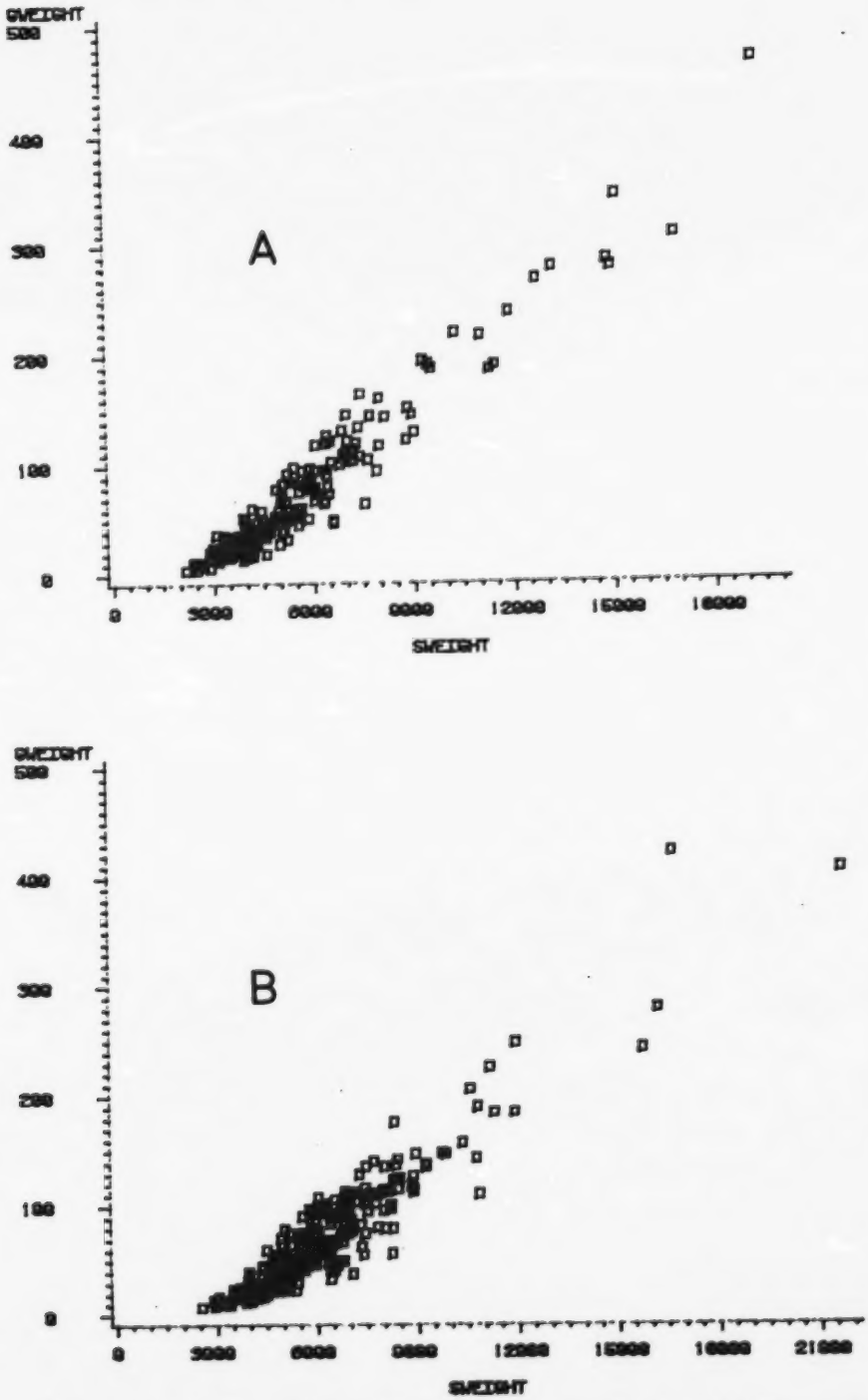

Fig. 11. Ovary weight (gweight) - somatic weight (sweight) relationships for lingcod sampled from A) off southwest Vancouver Island and B) Queen Charlotte Sound, R/V G.B. REED, August 20 - September 5, 1985. Weights shown are grams.